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MACHINE-AIDED INDEXING

Charles R. Jacobs

Defense Documentation Center
Alexandria, Virginia

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Directorate of Development

December 1972

Technical Progress Report for Period July 1971-June 1972

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| 13. ABSTRACT Progress is reported at the 1,000,000 word level on the development of a partial syntactic analysis technique for indexing text. A new indexing subroutine for hyphens is provided. New grammars written and programmed for MAI are discussed. |
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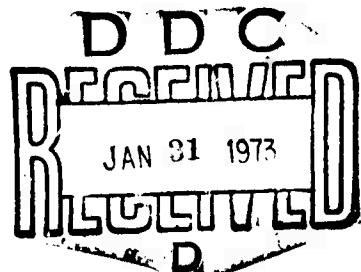


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PREFACE

This is the fourth annual report covering the development efforts in Machine-Aided Indexing (MAI). The partial automation of indexing is part of a larger effort which includes the automation of bibliographic searching so that the casual on-line user can receive a reasonable response to a question expressed in natural language. Both indexing from text and the use of natural language for search and retrieval require the existence of a large Natural Language Data Base (NLDB). Machine-Aided Indexing, Machine-Aided Retrieval (MAR) and the Natural Language Data Base are all at different levels of development.

To date, over one million running words of text have been processed through the MAI programs resulting in a find of 21,463 unique words. To our knowledge this is the first time automatic indexing procedures have been used on a data base of this magnitude. Furthermore, we are well on the way toward the two million word mark. Once this objective is reached it is anticipated that both the MAI and NLDB systems will be used in an operational environment.



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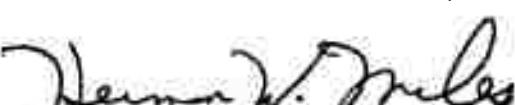
Efforts to convert the present MAI assembly language programs to COBOL are continuing. When completed, this conversion program will make MAI machine independent.

Prepared by:



CHARLES R. JACOBS
Directorate of Development

Approved by:



HERMAN W. MILES
Director, Directorate of
Development

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THE MACHINE-AIDED INDEXING SYSTEM

Recognition Dictionary

The format of this dictionary has been retained through the indexing of approximately 1,112,019 words of text. The present dictionary size is 21,000 unique words (see figure 1) with an anticipated increase of 8,000 new words of the next 1,000,000 words read resulting in a 29,000 word dictionary.

The statistics for the dictionary items assigned to each macro for the 1,112,019 words of text are as follows:

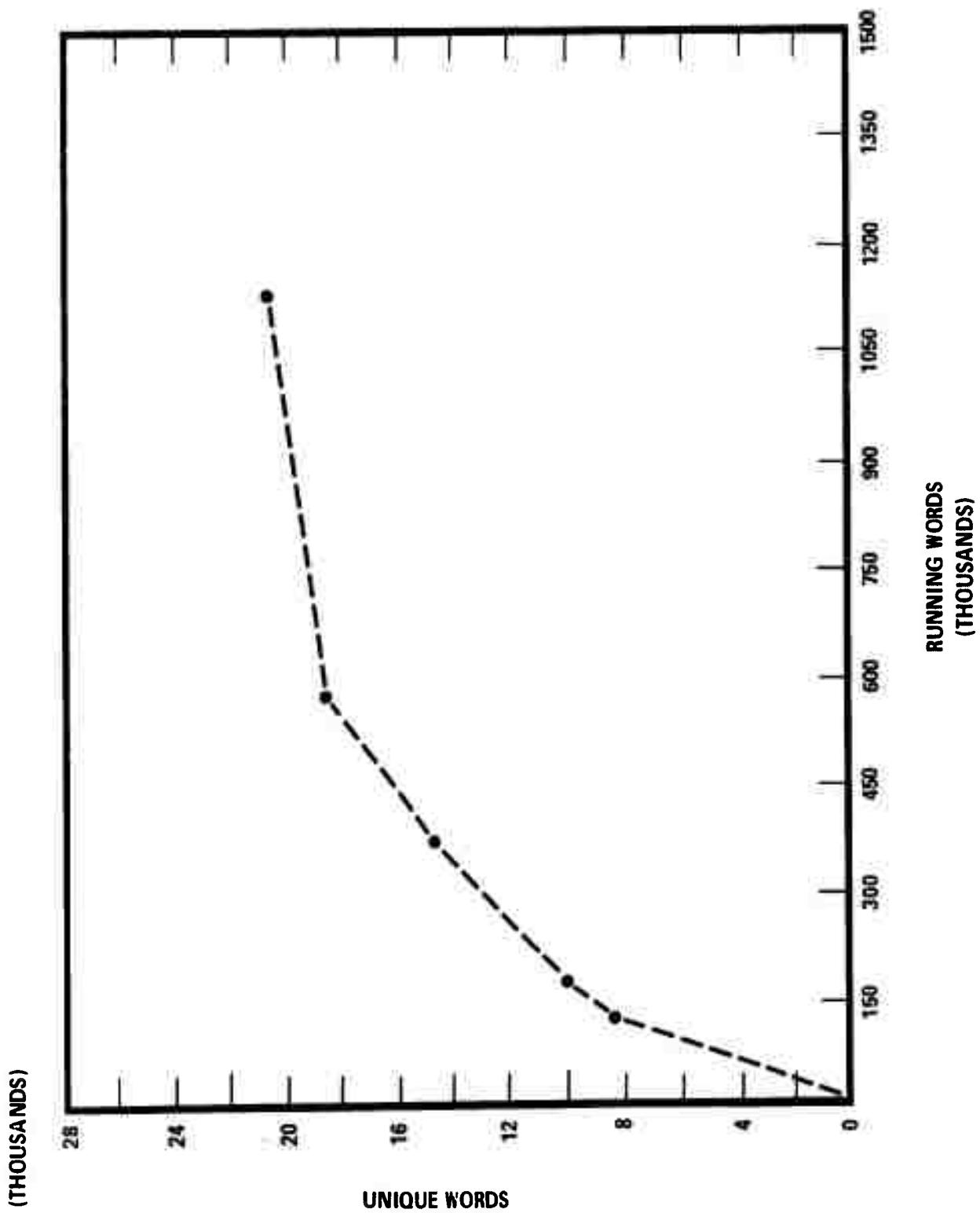
| <u>Macro</u> | <u>Words</u> | <u>Macro</u> | <u>Words</u> |
|--------------|-----------------|--------------|--------------|
| 0 | 792 | 9 | file routine |
| 1 | 9,507 | 10 | or |
| 2 | 2,974 | 11 | comma |
| 3 | 3,880 | 12 | 1 |
| 4 | 1 | 13 | hyphen test |
| 5 | special symbols | 14 | 11 |
| 6 | 4,182 | 15 | 9 |
| 7 | 6 | 16 | 53 |
| 8 | of | | |

Format Dictionary

The 77 formats recognized by the format dictionary and the frequency of their occurrence in the most recent 547,547 word data base are as follows:

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 1 | 13,799 | ZZ | 16 | 513 | NN |
| 2 | 11,478 | AZ | 17 | 488 | AZN |
| 3 | 9,479 | N | 18 | 454 | ZPN |
| 4 | 3,627 | AZZ | 19 | 450 | ZPZZ |
| 5 | 3,182 | ZZZ | 20 | 436 | AAZZ |
| 6 | 2,744 | NZ | 21 | 435 | ZNZ |
| 7 | 2,061 | AN | 22 | 366 | A+AZ |
| 8 | 1,703 | ZN | 23 | 352 | ZZN |
| 9 | 1,234 | AAZ | 24 | 235 | AAN |
| 10 | 1,095 | ZPZ | 25 | 231 | ZAZZ |
| 11 | 802 | ZAZ | 26 | 201 | AZAZ |
| 12 | 790 | AZZZ | 27 | 161 | ANZZ |
| 13 | 619 | ANZ | 28 | 160 | AZZZZ |
| 14 | 597 | NZZ | 29 | 158 | ZPAN |
| 15 | 551 | ZZZZ | 30 | 150 | ZAN |

Figure 1



| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 31 | 149 | NAZ | 53 | 33 | AR |
| 32 | 128 | BN | 54 | 32 | ZZZN |
| 33 | 123 | AZNZ | 55 | 29 | NNN |
| 34 | 120 | ZPNZ | 56 | 22 | NNZZ |
| 35 | 110 | NNZ* | 57 | 21 | AXAZ |
| 36 | 109 | A+ZZ | 58 | 18 | ZZR |
| 37 | 107 | NPZ | 59 | 14 | A+AZZZ |
| 38 | 96 | A+AZZ | 60 | 12 | AZR |
| 39 | 94 | NZZZ | 61 | 11 | AA+AZZ |
| 40 | 91 | ANN | 62 | 10 | ANZZZ |
| 40 | 91 | ZZAZ | 63 | 7 | A+YZ |
| 41 | 85 | ZZPZ | 64 | 6 | AXAZZ |
| 42 | 80 | AZAZZ | 65 | 5 | AA+AN |
| 43 | 78 | ZNZZ | 65 | 5 | ARZ |
| 44 | 77 | ZZZZZ | 66 | 4 | AXAN |
| 45 | 74 | ZR | 66 | 4 | A+XAZ |
| 46 | 71 | ZNZ | 66 | 4 | NAAZZ |
| 47 | 68 | AZZN | 66 | 4 | ZNZN |
| 48 | 58 | A+AN | 67 | 1 | A+YAN |
| 49 | 47 | ZAZZZ | 67 | 1 | BR |
| 50 | 45 | ZZPN | 68 | 0 | A+XAN |
| 51 | 42 | AA+AZ | 68 | 0 | A+YN |
| 52 | 40 | NAN | 68 | 0 | A+YZZ |
| 52 | 40 | ZNN | | | |

* The format NNZ was inadvertently omitted from the previous report where it should have been listed as having a frequency of 62 for the 450,000 word data base.

A new format not used for previous data bases is A+AZZZ with a frequency of 14. As found in the previous 450,000 word data base, the ZZ format still occurs most frequently. However, the next two pairs have reversed with AZ now preceding N and AZZ preceding ZZZ.

The following new formats have been added to the format dictionary:

AAZN
 ANNZ
 AZNN
 ZANZ
 A+NZ → AZ, NZ
 A+Z₁Z₂Z₃ → AZ₂Z₃, Z₁Z₂Z₃
 ZA₁+A₂N → ZA₁N, ZA₂N

Statistics for these formats will be forthcoming as new documentation is indexed.

The cumulative statistics for the frequency of occurrence of the 77 formats in the one million plus data base are as follows:

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 1 | 26,085 | ZZ | 40 | 167 | NZZZ |
| 2 | 20,539 | AZ | 40 | 167 | ANN |
| 3 | 18,633 | N | 41 | 160 | ZR |
| 4 | 6,433 | AZZ | 42 | 159 | ZZPZ |
| 5 | 6,155 | ZZZ | 42 | 159 | ZZZZ |
| 6 | 4,957 | NZ | 43 | 156 | ZNZZ |
| 7 | 3,635 | AN | 44 | 151 | AZAZZ |
| 8 | 3,185 | ZN | 45 | 128 | NZN |
| 9 | 2,274 | ZPZ | 46 | 122 | AZZN |
| 10 | 2,043 | AAZ | 47 | 108 | A+AN |
| 11 | 1,439 | ZAZ | 48 | 105 | ZZPN |
| 12 | 1,433 | AZZZ | 49 | 104 | AR |
| 13 | 1,104 | NZZ | 50 | 85 | AA+AZ |
| 14 | 1,089 | ANZ | 51 | 84 | ZAZZZ |
| 15 | 1,085 | ZZZZ | 52 | 83 | ZNN |
| 16 | 979 | NN | 53 | 68 | NAN |
| 17 | 972 | ZPZZ | 53 | 68 | ZZZN |
| 18 | 962 | ZPN | 54 | 64 | NNN |
| 19 | 953 | AZN | 55 | 42 | AXAZ |
| 20 | 782 | ZNZ | 56 | 38 | ZZR |
| 21 | 730 | AAZZ | 57 | 32 | NNZZ |
| 22 | 717 | A+AZ | 58 | 22 | AZR |
| 23 | 610 | ZZN | 59 | 19 | AA+AZZ |
| 24 | 432 | ZAZZ | 60 | 17 | ANZZZ |
| 25 | 367 | AZAZ | 60 | 17 | BR |
| 26 | 360 | AAN | 61 | 14 | A+AZZZ |
| 27 | 286 | AZZZZ | 62 | 12 | A+YZ |
| 28 | 284 | APAN | 62 | 12 | ZNZN |
| 29 | 273 | NAZ | 63 | 10 | AA+AN |
| 30 | 265 | ZAN | 63 | 10 | AXAN |
| 31 | 255 | ANZZ | 63 | 10 | NAAZZ |
| 32 | 246 | BN | 64 | 9 | AXAZZ |
| 33 | 229 | AZNZ | 65 | 8 | ARZ |
| 34 | 228 | ZPNZ | 66 | 6 | A+XAZ |
| 35 | 227 | NPZ | 67 | 3 | A+YZZ |
| 36 | 215 | A+ZZ | 68 | 2 | A+XAN |
| 37 | 181 | ZZAZ | 69 | 1 | A+YAN |
| 38 | 179 | NNZ | 70 | 0 | A+YN |
| 39 | 177 | A+AZZ | | | |

The first eight formats by frequency rank identically to that found for the 500K corpus. The remaining 69 formats vary somewhat. However, this variation is small and together with the passing of the one million word mark, it seems highly unlikely that any significant changes in ranking for a particular format will occur.

Natural Language Data Base (NLDB)

Presently, the NLDB contains some 48,663 records consisting of 4312 posting terms, 12,410 single use references, 29,652 multiple use references, and 2289 hierarchy references. These records reflect the MAI index terms for approximately 1750 DD 1634-resumes having an approximate total running word count of 600,000.

Various ways to automatically post certain categories of index terms are under investigation in an attempt to both speed up and, at the same time, reduce the manual effort required to bring this file up to an operational status.

One promising method involves automatically posting the singular or plural form of index terms as dictated by their presence already on the file in one form or the other. This routine greatly reduces the near-duplication of manual effort involved in updating the NLDB with singulars and plurals. Details on this will be published in the next NLDB report.

A technical progress report DDC-TR-72-1, "Natural Language Data Base" was published in May 1972 and is available as AD 746 600. This report follows DDC's development of a Natural Language Data Base from its inception to the present.

Indexing Subroutines (Macros)

Macro 13

- I. Is TS empty?
 - A. YES - Clear RR and read in next word.
 - B. NO - Store hyphen in TS - read in next word and go to step II.
- II. Is word followed by a hyphen?
 - A. YES - Go to IB
 - B. NO - Store an "A" in FR and term in TS. Read in next word.

Macro 13 in the above form is the subroutine involving the use of the hyphen. The 500K data base was the first real application of this Macro and, because of the encouraging results obtained, it is felt that a brief explanation of the subroutine is in order. What Macro 13 does is retain all hyphens together with the preceding and following word. This combination of word-hyphen-word is collectively stored as an adjective "A" and will combine with other "As," "Zs" and/or "Ns" to form the various formats. Thus we have the examples

over-the-horizon radar (AN), ship-to-shore radio (AZ), and solid-state devices (AZ) where, in each case, all words and their connecting hyphens are assigned as adjectives A and combine with nouns N and Z to form valid formats. There are problems. Not all hyphen-word combinations function as adjectives. These are being studied and modifications to the routines will be instituted when they are devised. However, the overall picture looks good.

Grammars

A right linear grammar was written and programmed for the MAI system. The 42 productions of this grammar generate exactly 2649 acceptable formats of four words or less. It was thought that this system would replace the present MAI system because of an anticipated growth of the format dictionary. However, this growth never materialized. In fact, it is now obvious that the format dictionary will have a total of less than 100 formats thus making the present MAI system faster than the grammar with no loss of efficiency.

Another right linear grammar was written and programmed to recognize AN/ equipment designations. This grammar, consisting of 33 productions, is stylized to make all AN designations potential index terms providing they satisfy certain criteria regarding the positions of the alphanumerics involved. This grammar generates an astounding multibillion potential for AN designations, and thus very compactly replaces an impossibly large look-up table. Furthermore, if study shows other alphanumeric combinations to be useful, we now have a technique for handling them. The actual results of using this grammar in a MAI operational mode will be covered in the next technical report.

NATURAL LANGUAGE DATA

Statistics

Once again, as with the 400K data base, we have the occurrence of long stretches of text, seven words or more, unbroken by a throw-away word. However, in comparing the 400K data base with the 500K data base it is noted that these occurrences reduced in number in almost every instance.

| | <u>400K</u> | <u>500K</u> |
|-------------------|-------------|-------------|
| 7 word stretches | 66 | 49 |
| 8 word stretches | 14 | 10 |
| 9 word stretches | 5 | 2 |
| 10 word stretches | 2 | 2 |

At this time, we can only assume that this is coincidental since there appears to be no sound basis for this type of trend. These occurrences are almost entirely controlled by the writing style of the document source.

It is still felt that stretches of text longer than four words are of questionable value for retrieval. Search requests are presently being analyzed to see if these same types of stretches appear. These findings will dictate our next step. That is, whether to allow five and six word formats to appear as we do now or whether to break them down into smaller, yet just as meaningful, formats. It is hoped that these procedures, if needed, will also apply to the longer stretches of seven words and greater.

Unclassified examples of authorized formats are given in Appendix A. Unclassified examples of unauthorized or mismatched formats are given in Appendix B. Unclassified formats of seven words or more follow in their entirety.

Seven Words

AAAAAAN - One- controlled gliding airdrop systems- external cargo
AAAANRN - Very hard frontal element- carbide cored projectiles
AAAZAZZ - Seaborne airborne opaque screen penetrating camera systems
AAAZZZZ - Skid-mounted closed Brayton cycle power conversion system
AAA+AAZ - X-ray far infrared and far ultra-violet rocket
AAA+AZZ - Clean trouble-free hydraulic and lubricating oil systems
AAA+ZAZ - Microelectronic linear digital and microwave integrated
circuits
Organic polymeric electronic and composite ceramic materials
AAZAAAZ - Of- high speed Morse telegraph telegraph terminal
AAZAZZZ - Running high speed digital data transmission tests
AAZZAZZ - High load-low speed water lubricated bearing systems
AA+AZAZ - Dimensional subsonic and transonic wind tunnel tests
AA+ZZZZ - In-house aerodynamic and life cycle cost studies
Tropospheric scatter and air ground radio links
ANZANZZ - Unidirectional graphite fiber phenylated quinoxaline
resin composite
ANZZAZZ - Liquefied petroleum gas fueled fork lift trucks
AZAAZNZ - Multi- parameter structural flight-maneuver load history data
AZAZZAZ - Low cost low installation cost intra-space cable
AZAZZZZ - Quick reaction technical information computer data bank
AZA+AZR - Digitally synthesized visual and audible output patterns
AZA+NAZ - Lightweight company mortar and battalion close support
AZA+ZNZ - Irradiated reactor structural and fuel cladding alloys
AZA+ZZZ - High Frequency bulk and surface wave applications
AZZAZZZ - Low energy electron diffraction-high energy electron
diffraction
AZZNAAZ - Single pass reverse osmosis fresh water system
AZZNNZZ - ECOM-wide material radiation vulnerability survivability
assessment program
AZZZZZZ - Automatic voice frequency circuit quality monitoring system
A+AAZZZ - Supersonic and hypersonic closed circuit wind tunnels
A+AXZZZ - Lethal and incapacitating or riot control agents
A+AZZNZ - Transonic and supersonic flight vehicle maneuverability
problems
A+ZZAAN - In-board and bomb rack stored rigid containers
A+ZZZZZ - Navigational and fire control weapon interface problems
BAAZAAN - New reactive tuning techniques high Q antennas
BAAZNAZ - New rugged quick-drying cotton nylon protective work
NAAZAAZ - Illumination modulated synchronized shutter underwater
viewing system
NAAZZZZ - LiOH ethylene-diamine tetracetic acid sea salt hardness
control tests
NZAANNZ - Graphite fiber reinforced pyrolytic graphite blast tube
NZAAZZZ - Loran techniques propagation--A least-squares coordinate
conversion techniques

NZANZZZ - Austenite grain boundaries- ferrite grain boundary networks
Loran techniques propagation--continue Loran anomaly
propagation studies
ZAAAZZZ - Size continually variable neutral density filter sets
ZAAZAAZ - Signal system- adjustable ranging telescope- automatic
alarm
ZAA+AZZ - Radiation hardened electric and magnetic field detectors
ZAZZAAZ - Ship sanitary waste transfer three dimensional bench
ZA+AANZ - North Atlantic and Mediterranean biological reverberation
models
ZA+AXAZ - Interface mechanical and digital or analog subsystems
ZA+AZZZ - Ground in-frame and out-of-frame jet engine test
ZA+YZAZ - Vehicle performance-soil and other vehicle performance-
terrain relations
ZNAAZZZ - Landing hook impact-resistant high intensity centerline
lights
ZNNANZZ - Breadboard hydrazine monopropellant integrated diver
power system
ZZA+AZZ - Rocket motor structural and thermal protection materials
ZZNZNNZ - Diesel engine cooling water corrosion inhibition techniques

Eight Words

ANZZZAZZ - Nuclear weapons effects research test nuclear effects
simulators
AZAAAZAN - High strength chemically resistant low temperature flexible
elastomers
AZAZAZNZ - High quality high strength high modulus carbon filament
A+NZZZZZ - Sam-D and manpads air defense systems cryptosecure computers
A+ZZZZZZ - Portable and shop gas turbine engine test facilities
BAZNNANZ - New high strength stress corrosion resistant aluminum alloy
NZAZZZZZ - Graphite fiber epoxy matrix composite wing box section
ZAAZAZZZ - Water impermeable high temperature resistant polymer
insulation system
ZA+AZZZZ - Reliable VHF-FM and UHF-AM frequency band avionics radio
sets
ZZAZZZZZ - Air defense small caliber fluid propellant weapon system

Nine Words

AA+AZZZZZ - Manned hyperbaric and deep ocean simulation pressure
changer complexes
A+AZZAZZZ - Forward and remote surface observations meteorological data
sounding system

Ten Words

AZZAAAZAZN - High speed data buffer ultra high speed digital group multiplexer

ZNPZAAZAZZ - Compression molding of water impermeable high temperature resistant polymer insulation

In all of the format examples including both appendices, it is interesting to note the impact regarding the use of the hyphen (-). This new MAI procedure has enhanced our ability to keep strings of text together thereby keeping ideas and concepts from being lost. Numerous new index terms now appear which would previously have been deleted or broken up. Indications are that the hyphen routine is a definite plus for the MAI system.

Incorrect Assignment

We now have programs that will index phrases using a variable macro assignment for a given word. This will not only give us a picture of how a word combines with other words when assigned various parts of speech but it will also enable us to more quickly and easily assign the most correct macro to troublesome words. Results of this effort will be reported in later technical reports.

Format Mismatches

Once again, a record was made of those strings of text which have no counterpart in the format dictionary. This record, together with past records, will be used to determine if valuable formats are being lost. The nonmatching formats for this latest data base and their frequency of occurrence are as follows:

Mismatch Formats by Frequency

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 1 | 43,464 | Z | 14 | 63 | AAZN |
| 2 | 1,162 | B | 15 | 60 | AANZ |
| 3 | 1,080 | A | 16 | 44 | AAAZZ |
| 4 | 863 | BZ | 16 | 44 | ZAAZ |
| 5 | 190 | BZZ | 17 | 43 | BZZZ |
| 6 | 159 | A+ | 18 | 41 | BNZ |
| 7 | 116 | AA | 19 | 40 | A+NZ |
| 8 | 115 | AAAZ | 20 | 39 | A+ZZZ |
| 9 | 97 | BAZ | 21 | 37 | ZBZ |
| 10 | 93 | A+Z | 22 | 37 | ZZAZZ |
| 11 | 84 | ZA | 23 | 36 | AZAN |
| 11 | 84 | ZZNZ | 24 | 35 | A+AAZ |
| 12 | 66 | AAZZZ | 25 | 32 | AZZAZ |
| 13 | 64 | AX | 26 | 30 | RAZZ |

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 27 | 29 | NAZZ | 44 | 11 | ZBZZ |
| 28 | 28 | ZAZN | 44 | 11 | ZNNZ |
| 29 | 27 | AA+ | 45 | 10 | AAA+ |
| 29 | 27 | ABZ | 45 | 10 | AANZZ |
| 29 | 27 | AZZZZ | 45 | 10 | AZAZN |
| 30 | 26 | A+N | 45 | 10 | A+A |
| 30 | 26 | ZANZ | 45 | 10 | A+B |
| 31 | 25 | NZAZ | 45 | 10 | NAAZ |
| 32 | 24 | AAAZAZ | 45 | 10 | NAZZZ |
| 33 | 23 | AAZZZZ | 45 | 10 | ZANZZ |
| 33 | 23 | AB | 45 | 10 | ZA+ZZ |
| 33 | 23 | ZB | 45 | 10 | ZRZ |
| 34 | 22 | AZNN | 46 | 9 | ANZN |
| 34 | 22 | NR | 45 | 9 | A+X |
| 35 | 21 | ANAZ | 46 | 9 | ZAZAZ |
| 36 | 20 | AAZNZ | 46 | 9 | ZAZZZZ |
| 36 | 20 | AZZNZ | 47 | 8 | AA+Z |
| 37 | 19 | AAAAAZ | 47 | 8 | A+AAZZ |
| 37 | 19 | AAAN | 47 | 8 | BAAZZ |
| 37 | 19 | ANNZ | 47 | 8 | NA |
| 37 | 19 | AZAAZ | 47 | 8 | NNNZ |
| 38 | 17 | ZA+AZ | 47 | 8 | ZAZNZ |
| 39 | 16 | AAA | 47 | 8 | ZA+ |
| 39 | 16 | BZN | 47 | 8 | ZZZNZ |
| 40 | 15 | AAA+AZ | 47 | 8 | ZZZZZZ |
| 40 | 15 | BAAZ | 48 | 7 | A+ZNZ |
| 40 | 15 | BANZ | 48 | 7 | ZAANZ |
| 40 | 15 | NANZ | 48 | 7 | ZZANZ |
| 40 | 15 | ZZZAZ | 48 | 7 | ZZAZZZ |
| 41 | 14 | AZA | 48 | 7 | ZZNN |
| 41 | 14 | AZAZZZ | 49 | 6 | AAAAN |
| 41 | 14 | A+ZN | 49 | 6 | AANN |
| 41 | 14 | ZA+Z | 49 | 6 | AAZANZ |
| 41 | 14 | ZNAZ | 49 | 6 | AAAZAZ |
| 42 | 13 | A+BZ | 49 | 6 | AA+NZ |
| 42 | 13 | NZZZZ | 49 | 6 | A+NAZ |
| 42 | 13 | ZZA | 49 | 6 | BAZZZ |
| 42 | 13 | ZZNZZ | 49 | 6 | BNZZ |
| 43 | 12 | AAAZZZ | 49 | 6 | BZZZZ |
| 43 | 12 | AA+ZZ | 49 | 6 | NZAN |
| 43 | 12 | AZNZZ | 50 | 5 | AAAAZZ |
| 43 | 12 | A+AZN | 50 | 5 | AAR |
| 43 | 12 | BAN | 50 | 5 | AA+N |
| 43 | 12 | ZAAZZ | 50 | 5 | ABZZ |
| 43 | 12 | ZZAN | 50 | 5 | AXZZ |
| 44 | 11 | AZANZ | 50 | 5 | AZNAZ |
| 44 | 11 | BBAZ | 50 | 5 | AZZR |
| 44 | 11 | ZAAN | 50 | 5 | AZZAZ |

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 50 | 5 | A+ANZ | 52 | 3 | BZAZZ |
| 50 | 5 | A+ZNN | 52 | 3 | BZZN |
| 50 | 5 | NB | 52 | 3 | NAZN |
| 50 | 5 | NZA | 52 | 3 | NA+Z |
| 50 | 5 | NZNZ | 52 | 3 | NNAZ |
| 50 | 5 | ZA+ZZZ | 52 | 3 | NZAZN |
| 50 | 5 | ZNZZZ | 52 | 3 | NZB |
| 50 | 5 | ZZBZ | 52 | 3 | ZA+NZ |
| 50 | 5 | ZZZN | 52 | 3 | ZEN |
| 51 | 4 | ANA | 52 | 3 | ZZB |
| 51 | 4 | ANZNZ | 52 | 3 | ZZZAZZ |
| 51 | 4 | AZB | 51 | 2 | AAAAAZ |
| 51 | 4 | A+NN | 51 | 2 | AAANZ |
| 51 | 4 | A+NZZ | 51 | 2 | AAAZNZ |
| 51 | 4 | A+ZAZ | 51 | 2 | AAA+ZZ |
| 51 | 4 | A+AZAZ | 51 | 2 | AAB |
| 51 | 4 | BAR | 51 | 2 | AAX |
| 51 | 4 | BA+AZ | 51 | 2 | AA+A |
| 51 | 4 | NAAN | 51 | 2 | AA+AAN |
| 51 | 4 | NA+AZ | 51 | 2 | AA+BZ |
| 51 | 4 | NNAN | 51 | 2 | AA+NZZ |
| 51 | 4 | NZAZZ | 51 | 2 | AA+ZN |
| 51 | 4 | ZAAAZ | 51 | 2 | AA+ZZZ |
| 51 | 4 | ZAZZN | 51 | 2 | ABZZZ |
| 51 | 4 | ZA+AZZ | 51 | 2 | ANAAZ |
| 51 | 4 | ZA+N | 51 | 2 | ANAN |
| 51 | 4 | ZNNZZ | 51 | 2 | AXAAZ |
| 51 | 4 | ZZAAZ | 51 | 2 | AXANZ |
| 51 | 4 | ZZAZN | 51 | 2 | AZAX |
| 51 | 4 | ZZZR | 51 | 2 | AZAZAZ |
| 52 | 3 | AAAZN | 51 | 2 | AZA+ |
| 52 | 3 | AAZAN | 51 | 2 | AZA+Z |
| 52 | 3 | AAZNZZ | 51 | 2 | AZNZN |
| 52 | 3 | AAZZN | 51 | 2 | AZNR |
| 52 | 3 | ANR | 51 | 2 | AZNZAZ |
| 52 | 3 | AXZ | 51 | 2 | AZRZ |
| 52 | 3 | AZAAN | 51 | 2 | AZZNN |
| 52 | 3 | AZAAZZ | 51 | 2 | AZZNZZ |
| 52 | 3 | AZANZZ | 51 | 2 | A+AAN |
| 52 | 3 | AZAR | 51 | 2 | A+AZAZ |
| 52 | 3 | AZBZ | 51 | 2 | A+BN |
| 52 | 3 | AZNNZ | 51 | 2 | A+BZZ |
| 52 | 3 | AZNZZZ | 51 | 2 | A+XZ |
| 52 | 3 | AZZAN | 51 | 2 | A+ZAAZ |
| 52 | 3 | AZZAZZ | 51 | 2 | BAANZ |
| 52 | 3 | AZZZN | 51 | 2 | BAA+AZ |
| 52 | 3 | AZZZNZ | 51 | 2 | BAZN |
| 52 | 3 | BA+AZZ | 51 | 2 | BB |
| 52 | 3 | BA+Z | 51 | 2 | BZZNZZ |

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 51 | 2 | NAAAAZ | 52 | 1 | AAZAAZ |
| 51 | 2 | NAAA AZ | 52 | 1 | AAZAZZ |
| 51 | 2 | NA+ZZ | 52 | 1 | AAZR |
| 51 | 2 | NNZN | 52 | 1 | AAZZA |
| 51 | 2 | NNZZZ | 52 | 1 | AAZZB |
| 51 | 2 | NRZ | 52 | 1 | AAZZNZ |
| 51 | 2 | NZR | 52 | 1 | AAZZR |
| 51 | 2 | NZZN | 52 | 1 | AA+AAZ |
| 51 | 2 | ZAA | 52 | 1 | AA+AZN |
| 51 | 2 | ZAAZN | 52 | 1 | AA+B |
| 51 | 2 | ZAAZZZ | 52 | 1 | AA+NNZ |
| 51 | 2 | ZAA+ | 52 | 1 | AA+X |
| 51 | 2 | ZANNZ | 52 | 1 | AA+ZAZ |
| 51 | 2 | ZAR | 52 | 1 | ABAZ |
| 51 | 2 | ZAX | 52 | 1 | ANANN |
| 51 | 2 | ZAZAAZ | 52 | 1 | ANANZ |
| 51 | 2 | ZAZR | 52 | 1 | ANAZN |
| 51 | 2 | ZA+YZ | 52 | 1 | ANAAAZ |
| 51 | 2 | ZA+ZN | 52 | 1 | ANNN |
| 51 | 2 | ZBAZZ | 52 | 1 | ANNZZ |
| 51 | 2 | ZNANZ | 52 | 1 | ANZAAZ |
| 51 | 2 | ZNAZZ | 52 | 1 | ANZAN |
| 51 | 2 | ZNR | 52 | 1 | ANZAZ |
| 51 | 2 | ZZAAZZ | 52 | 1 | ANZZN |
| 51 | 2 | ZZA+Z | 52 | 1 | ANZZZZ |
| 51 | 2 | ZZA+ZZ | 52 | 1 | AXZZZ |
| 51 | 2 | ZZNAZN | 52 | 1 | AZANAZ |
| 51 | 2 | ZZZNZZ | 52 | 1 | AZAXN |
| 52 | 1 | AAAA | 52 | 1 | AZAXZ |
| 52 | 1 | AAAAAX | 52 | 1 | AZAZNZ |
| 52 | 1 | AAA AZN | 52 | 1 | AZAZZN |
| 52 | 1 | AAA B | 52 | 1 | AZA+AZ |
| 52 | 1 | AAANZN | 52 | 1 | AZA+YZ |
| 52 | 1 | AAA ZAN | 52 | 1 | AZA+ZZ |
| 52 | 1 | AAA ZAZ | 52 | 1 | AZBN |
| 52 | 1 | AAA+N | 52 | 1 | AZNAAZ |
| 52 | 1 | AAA+Z | 52 | 1 | AZNAZZ |
| 52 | 1 | AAA+ZN | 52 | 1 | AZZAAN |
| 52 | 1 | AABNZ | 52 | 1 | AZZANZ |
| 52 | 1 | AABZZ | 52 | 1 | AZZAZN |
| 52 | 1 | AANA | 52 | 1 | AZZB |
| 52 | 1 | AANR | 52 | 1 | AZZZR |
| 52 | 1 | AANZAZ | 52 | 1 | AZZZN |
| 52 | 1 | AANZZZ | 52 | 1 | A+AA |
| 52 | 1 | AAXAZZ | 52 | 1 | A+AAA AZ |
| 52 | 1 | AAXN | 52 | 1 | A+AA NZ |
| 52 | 1 | AAXZ | 52 | 1 | A+AAR |
| 52 | 1 | AAXZZ | 52 | 1 | A+ABZ |
| 52 | 1 | AAZA | 52 | 1 | A+ANN |
| 52 | 1 | AAZAAN | 52 | 1 | A+AR |

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 52 | 1 | A+AZNZ | 52 | 1 | NAR |
| 52 | 1 | A+AZZN | 52 | 1 | NAZAZZ |
| 52 | 1 | A+BZN | 52 | 1 | NA+ |
| 52 | 1 | A+NZN | 52 | 1 | NA+N |
| 52 | 1 | A+XAAZ | 52 | 1 | NA+ZN |
| 52 | 1 | A+XAZZ | 52 | 1 | NNAAN |
| 52 | 1 | A+XBZ | 52 | 1 | NNAZZ |
| 52 | 1 | A+XZZ | 52 | 1 | NNNAZN |
| 52 | 1 | A+Y | 52 | 1 | NNNAZZ |
| 52 | 1 | A+YAZ | 52 | 1 | NNZAZ |
| 52 | 1 | A+YNZ | 52 | 1 | NNZNZ |
| 52 | 1 | A+ZAN | 52 | 1 | NZAANN |
| 52 | 1 | A+ZNZZ | 52 | 1 | NZNAZ |
| 52 | 1 | A+ZZB | 52 | 1 | NZNN |
| 52 | 1 | A+ZZN | 52 | 1 | NZNZZ |
| 52 | 1 | A+ZZZZ | 52 | 1 | NZZR |
| 52 | 1 | BA | 52 | 1 | NZZZZZ |
| 52 | 1 | BAA | 52 | 1 | ZAAA |
| 52 | 1 | BAAANZ | 52 | 1 | ZAAA |
| 52 | 1 | BAAAZ | 52 | 1 | ZAAAZZ |
| 52 | 1 | BAAN | 52 | 1 | ZAANN |
| 52 | 1 | BAAZN | 52 | 1 | ZAANZZ |
| 52 | 1 | BAAZNZ | 52 | 1 | ZAAR |
| 52 | 1 | BAAZZZ | 52 | 1 | ZAAZNZ |
| 52 | 1 | BANN | 52 | 1 | ZAAZZN |
| 52 | 1 | BANZZ | 52 | 1 | ZAA+AZ |
| 52 | 1 | BAZAAZ | 52 | 1 | ZAA+ZZ |
| 52 | 1 | BAZANZ | 52 | 1 | ZANAAZ |
| 52 | 1 | BAZAZ | 52 | 1 | ZANR |
| 52 | 1 | BAZNZ | 52 | 1 | ZANRZ |
| 52 | 1 | BA+AAZ | 52 | 1 | ZANZZZ |
| 52 | 1 | BA+ZZ | 52 | 1 | ZARA |
| 52 | 1 | BBNZ | 52 | 1 | ZARZ |
| 52 | 1 | BNAZ | 52 | 1 | ZAXAZ |
| 52 | 1 | BNN | 52 | 1 | ZAZNRZ |
| 52 | 1 | BNNZ | 52 | 1 | ZAZZAZ |
| 52 | 1 | BNZN | 52 | 1 | ZAZZNZ |
| 52 | 1 | BNZZZ | 52 | 1 | ZAZZZN |
| 52 | 1 | BZA | 52 | 1 | ZAZZZR |
| 52 | 1 | BZAZZZ | 52 | 1 | ZA+ANZ |
| 52 | 1 | BZNZ | 52 | 1 | ZA+BZ |
| 52 | 1 | BZZNZ | 52 | 1 | ZA+NZZ |
| 52 | 1 | BZZR | 52 | 1 | ZA+YN |
| 52 | 1 | NAA | 52 | 1 | ZA+YZZ |
| 52 | 1 | NAABZZ | 52 | 1 | ZA+ZNZ |
| 52 | 1 | NAA+NZ | 52 | 1 | ZA+ZZR |
| 52 | 1 | NANN | 52 | 1 | ZBAZZZ |
| 52 | 1 | NANNN | 52 | 1 | ZBZZZ |
| 52 | 1 | NANZZ | 52 | 1 | ZNAAZ |

| <u>Rank</u> | <u>Frequency</u> | <u>Format</u> | <u>Rank</u> | <u>Frequency</u> | <u>Format</u> |
|-------------|------------------|---------------|-------------|------------------|---------------|
| 52 | 1 | ZNAA | 52 | 1 | ZZA+AZ |
| 52 | 1 | ZNAN | 52 | 1 | ZZBN |
| 52 | 1 | ZNAZN | 52 | 1 | ZZBZZ |
| 52 | 1 | ZNBZ | 52 | 1 | ZZNAN |
| 52 | 1 | ZNBZZZ | 52 | 1 | ZZNNN |
| 52 | 1 | ZNNNN | 52 | 1 | ZZNNZ |
| 52 | 1 | ZNNNZZ | 52 | 1 | ZZNZAZ |
| 52 | 1 | ZNZA | 52 | 1 | ZZNZN |
| 52 | 1 | ZNZZZ | 52 | 1 | ZZRZ |
| 52 | 1 | ZZAAN | 52 | 1 | ZZZB |
| 52 | 1 | ZZAANZ | 52 | 1 | ZZZRZZ |
| 52 | 1 | ZZAAZN | 52 | 1 | ZZZZBZ |
| 52 | 1 | ZZANZZ | 52 | 1 | ZZZZNZ |
| 52 | 1 | ZZAZAZ | 52 | 1 | ZZZZZN |

An interesting comparison with statistics from the three corpora follows:

| <u>Rank</u> | <u>100K</u> | <u>400K</u> | <u>500K</u> |
|-------------|-------------|-------------|-------------|
| 1 | 10,470(Z) | 32,281(Z) | 43,464(Z) |
| 2 | 197(A) | 906(B) | 1,162(B) |
| 3 | 171(R) | 657(BZ) | 1,080(A) |
| 4 | 152(B) | 591(A) | 863(BZ) |

The occurrence of R in the 100K corpus was a one time occurrence since the programs have now been revised to eliminate this format completely. With this one exception the majority of the format mismatches for all three corpora involve Z, A, B and BZ. The 400K and 500K statistics are quite similar except for a reversal of BZ and A in the third and fourth positions. It is interesting to note that A has fluctuated from second to fourth and back to a strong third. This indicates probable variations in writing style and will be closely watched, especially when a new data base is indexed.

The overall mismatch statistics of the three corpora are quite similar. The first four mismatches accounted for 94.6 percent of the mismatches in the first case, 94.8 percent in the second and 93.2 percent in the third.

Most of the formats which were immediately rejected in the previous corpora also appear in the 500K corpus.

| <u>Format</u> | <u>100K</u> | <u>400K</u> | <u>500K</u> | <u>Format</u> | <u>100K</u> | <u>400K</u> | <u>500K</u> |
|---------------|-------------|-------------|-------------|---------------|-------------|-------------|-------------|
| A | 197 | 591 | 1080 | AZA | - | - | 14 |
| A+ | 42 | 88 | 159 | NA | - | - | 8 |
| A+Z | 20 | 63 | 93 | NB | - | - | 5 |
| AA | 16 | 46 | 116 | NZA | - | - | 5 |
| AX | 11 | 34 | 64 | ANA | - | - | 4 |
| A+R | 11 | 13 | - | AZB | - | - | 4 |
| ZA | 4 | 28 | 84 | BA+Z | - | - | 3 |
| AA+A | 3 | 15 | 2 | NZB | - | - | 3 |
| A+X | 3 | 9 | 9 | ZZB | - | - | 3 |
| AAA | 2 | 9 | 16 | AZAX | - | - | 2 |
| A+B | 2 | 55 | 10 | AZA+ | - | - | 2 |
| ZA+ | 2 | 2 | 8 | BB | - | - | 2 |
| AXZ | 2 | 2 | 3 | AAAA | - | - | 1 |
| A+A | 1 | 12 | 10 | AAAAAX | - | - | 1 |
| AAAAAX | 1 | - | - | AANA | - | - | 1 |
| AXA | 1 | - | - | AAZA | - | - | 1 |
| A+XA | 1 | - | - | AAZZB | - | - | 1 |
| ZYZ | 1 | - | - | AA+X | - | - | 1 |
| ZB | - | 13 | 23 | AZZB | - | - | 1 |
| AB | - | 13 | 23 | A+Y | - | - | 1 |
| ZZA | - | 7 | 13 | BAA | - | - | 1 |
| BA | - | 5 | 1 | NAA | - | - | 1 |
| ZAA | - | 4 | 2 | NA+ | - | - | 1 |
| BA+ | - | 3 | 1 | ZAAA | - | - | 1 |
| AAB | - | 2 | 2 | ZARA | - | - | 1 |
| AAX | - | 2 | 2 | ZNAA | - | - | 1 |
| AAA+ | - | 2 | 10 | ZNZA | - | - | 1 |
| AA+ | - | - | 27 | ZZZB | - | - | 1 |
| A+N | - | - | 26 | | | | |

There are 30 new formats in the 500K corpus which can be categorized as immediate rejects. This is a considerable increase over the 9 new immediate reject formats which appeared at the time of the 400K corpus and indicates that, contrary to expectations, reaching the one million word level has not resulted in any decrease or leveling-off of new invalid formats.

PLANS FOR FY 73

1. The data base will be doubled.
2. Different data bases will be investigated.
3. The investigation of troublesome words will continue.
4. A report will be issued emphasizing statistics at the 2,000,000-word level.

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3. Klingbiel, Paul H., Machine-Aided Indexing, Report DDC-TR-71-7, AD 733 800.
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APPENDIX A
CURRENT FORMAT MATCHES

AAN

Aromatic organic polymers
Military internal medicine
Small tactical radios

AAZ

Airborne digital computer
Ceramic conical shapes
Fluidic analog controller

AAZZ

Automatic electric power plant
Gyro-stabilized airborne laser system
Small automatic gas turbine

AA+AN

Angular, linear and simultaneous accelerations
Angular accelerations
Linear accelerations
Simultaneous accelerations
Sedimentary, tectonic and volcanic history
Sedimentary history
Tectonic history
Volcanic history

AA+AZ

Biochemical, clinical and pharmacological research
Biochemical research
Clinical research
Pharmacological research
Intergalactic, interplanetary and interstellar forces
Intergalactic forces
Interplanetary forces
Interstellar forces

AA+AZZ

Vehicular, manpack and airborne radio sets
Vehicular radio sets
Manpack radio sets
Airborne radio sets

AXAZZ

- Conical or flat disc windows
 - Conical disc windows
 - Flat disc windows
- Signal or dual rail launcher
 - Signal rail launcher
 - Dual rail launcher

AZ

- Aerial delivery
- Integrated system
- Zeeman effect

AZAZ

- Fixed wing naval aircraft
- High expansion foam systems
- Phased array scanned laser

AZAZZ

- High speed coastal survey techniques
- Low cost low weight missiles
- Open circuit hot water systems

AZN

- Cold weather clothing
- High performance airfoils
- TOXIC missile fuels

AZNZ

- High temperature titanium alloy
- Underwater communication intelligibility studies

AZR

- High-risk drug abusers
- Naval ship routing

AZZ

- Acoustic propagation problems
- Modular power supplies
- Primary flight control

AZZN

Deep ocean protection survival
Limited test ban treaty
Single air search radar

AZZZ

Automatic flight control system
Integrated fire control system
Optical character recognition test

AZZZZ

Electric arc driver shock tube
Low noise soild state amplifier

A+AN

Antipersonnel and antimateriel bomblets
Antipersonnel bomblets
Antimateriel bomblets
Frozen and thawed soils
Frozen soils
Thawed soils
Internal and external blast
Internal blast
External blast

A+AZ

Acoustic and electromagnetic propagation
Acoustic propapation
Electromagnetic propagation
Fixed and rotary wing
Fixed wing
Rotary wing
Wheeled and tracked vehicles
Wheeled vehicles
Tracked vehicles

A+AZZ

Biological and chemical protection studies
Biological protection studies
Chemical protection studies
Small and full-scale wind tunnels
Small wind tunnels
Full-scale wind tunnels
Tactical and strategic missile systems
Tactical missile systems
Strategic missile systems

A+AZZ

Fixed and rotary wing army aircraft
 Fixed wing army aircraft
 Rotary wing army aircraft
Acoustic and electromagnetic signal processing techniques
 Acoustic signal processing techniques
 Electromagnetic signal processing techniques
Behavioral and social science research products
 Behavioral science research products
 Social science research products

A+XAZ

Electrical and/or mechanical elements
 Electrical elements
 Mechanical elements
Decontaminating and/or sterilizing agents
 Decontaminating agents
 Sterilizing agents

A+YAN

Oceanographic and other underwater transducers
 Oceanographic transducers
 Underwater transducers

A+YZ

Fabric and other surfaces
 Fabric surfaces
Pharmacological and other techniques
 Pharmacological techniques

A+ZZ

Wheeled and tracklaying vehicles
 Wheeled vehicles
 Tracklaying vehicles
Clinical and laboratory studies
 Clinical studies
 Laboratory studies
Fresh and salt water
 Fresh water
 Salt water

BN

New cannon
New drugs
New handbooks

AN

Biological aerosols
Marine mammals
Protective clothing

ANN

Low drag bombs
Military dog nutrition
Rough terrain forklifts

ANZ

Automatic welding technique
Cold fog chamber
Mobile firepower systems

ANZZ

Dual radar control system
High elongation suspension lines
Portable hydrazine fuel system

ANZZZ

Automated wire rope information system
Nuclear weapons effects research program

AR

Nuclear device
Tuning device
Underwater device

ARZ

Planar routing algorithm
Tactical maneuver elements

AXAN

Fiber-reinforced or laminated composites
Fiber-reinforced composites
Laminated composites
Single or multiple stresses
Single stresses
Multiple stresses

AXAZ

Stationary or moving targets
Stationary targets
Moving targets
Thermal or rolling shock
Thermal shock
Rolling shock

BR

Collision breakup

N

Acoustics
Electronics
Speech

NAAZZ

Turbidity penetrating underwater camera system
Welding very high strength metals

NAN

Aluminum coated fasteners
Smoke resistant elastomers

NAZ

ASW avionic systems
Blast resistant materials
CB protective equipment

NN

ASW sensors
Jungle canopy
Transducer head

NNN

Armor survival vest
Rat brain microsomes
Silver zinc batteries

NNZ

Arctic ice areas
Oxygen atom reactions
Titanium aluminum alloys

NNZZ

BW CW explosive safety
UHF transceiver breadboard test

NZ

Accelerometer studies
Balloon system
Raindrop size

NZN

Carbon fiber composites
Head motion sensors
Laundry room fires

NZZ

Aluminum alloy cases
Muzzle gas flow
Radar fire control

NZZZ

ASW missile launching system
CVA message flow systems
Silicon scan converter tube

ZAN

Army mental hygiene
Gas lubricated bearings
Submarine acoustic emissions

ZAZ

Adhesive bonded joints
Navy distillate fuel
North Pacific areas

ZAZZ

Computer assisted war gaming
Fleet numerical weather central
Standard military communication equipment

ZAZZZ

Army unattended ground sensor system
Navy airborne power supply requirements
Prototype nuclear water level indicator

ZN

Field artillery
Pressure hull
Waste disposal

ZNN

Ethylene rubber seals
Liquid dye lasers
Steel tricon containers

ZNZ

Adult learning problems
Helicopter armament systems
Sea ice research

ZNZN

Neutron radiography defect detection

ZNZZ

Combat crew training levels
Home fallout shelter survey
Submarine diving plane tests

ZR

Display device
Life saving
Safety device

ZZ

Circuit theory
Launch angle
Rendezvous system

ZZN

Bomb rack stowage
Engine compartment fires
Water base fluids

ZZPN

Flight testing of antennas
 Flight testing
 Antennas
Surface layers of ceramics
 Surface layers
 Ceramics
Radiation preservation of food
 Radiation preservation
 Food

ZZI.

Altitude control device
Mass storage device
Sensor simulation device

ZZZ

Air force operations
Data system elements
Power supply problems

ZZZN

Dry cleaning plant emissions
Foreign air defense guns
Solid state laser diodes

ZZZZ

Electron beam image projection
Flight deck edge antenna
Submarine shock test vehicle

ZZZZZ

Army air traffic management functions
Emergency life boat flash lights
Solid state power conversion equipment

APPENDIX B
FORMAT MISMATCHES

AAAAN

Unidirectional prestressed reinforced pyrolytic graphite
Western United States- physical geography

AAAАЗ

First-in first-out universal buffer memory
Gimbal mounted semi-rigid tilt rotor
Integrated navigational geophysical positioning
Novel high-powered liquid-cooled S-band tube
Three dimensional supercavitating lifting theory
Three navy-developed hot-corrosion resistant alloys
Very thin porous leading edge
Wound free flooded magnetostriuctive array

AAAАЗN

Cordless tactical electronic semiautomatic telephone switchboard

AAAB

HF VHF-FM VHF-AM new

AAAN

Air-droppable tactical meteorological buoy
Night downward looking periscope
Pulsed automatic pipe welding
Skirted air-cushion planning hull
Very soft cohesive soils

AAANZ

Strapdown airborne inertial navigation systems

AAANZN

Ultra lightweight tactical battlefield surveillance radar

AAAZ

Alpha beta gamma neutron
Close coupled canard surfaces
Digital coded firing system
Folding fin aerial rocket
High powered acoustic sources
Lightweight cold wet boot
Long standing nuclear threat
Naval amphibious logistic system
Remotely emplaced anti-personnel mines
Rugged miniature low cost
Small portable self-contained systems
Tandem Van De Graaff
Thermally stable organic materials
Very hard front face

AAAZN

Electronically tuned microelectronic receiver tuner
Vibrile upper respiratory tract infection

AAAZNZ

Manually powered portable shelter ventilation systems

AAAZZ

All-weather day-night topographic mapping system
Automatic manual sealed distress light
Integrated tactical airborne control system
Powered wheeled military transport vehicles
Smaller lighter high reliability devices
Vertically polarized radiometric brightness temperature

AAAZZZ

Dual-turbine hybrid electric propulsion test rig
Navy-wide integrated logistic control information system
Portable shipboard upper air sounding system

AAA+AZ

Biochemical enzymatic immunological and physical properties
Electronic ionic atomic and molecular reactions
Structural electrical magnetic and optical functions

AAA+Z

Alpha beta gamma and neutron

AAA+ZN

Biochemic immunologic pathologic and performance degradation

AAA+ZZ

Tunable infra-red sub-millimeter and millimeter receivers

AABZZ

High-speed block-oriented random access memory

AANN

Antimaterial incendiary fragmentation bomblet
Latent avian malaria infections

AANR

Automatic life-preserver inflation device

AANZ

Far infrared vision systems
Hot pressed titanium diboride
Least toxic corrosion inhibitors
Long internal gravity waves
Low-level neural activation studies
Safe tire inflation system
Three commercial dust respirators
Unstemmed nuclear cratering detonations

AANZAZ

All-optical automatic weapons load positioning system

AANZZ

Defense-oriented nuclear weapon effects research
Global biological reverberation prediction models

AANZZZ

High-energy short-pulse hydrogen fluoride laser radiation

AAR

External lighting device

AAXAZZ

Simulated nuclear or high explosive environments

AAXN

Therapeutic prophylactic or detection

AAXZ

Technical administrative or combat

AAXZZ

Passive semi-active or active mode

AAZAAN

Compact closed cycle lightweight miniature refrigerators

AAZAAZ

Structural tuning recoil soft mounting barrel

AAZANZ

Precision synchronous beacon acoustic navigation system

AAZAZ

**High Reynolds number transonic flow
Self-cleaning high intensity incandescent lamps
Very high quality photographic enlarger
Worldwide logistic system are- simulation**

AAZAZZ

Very low cost strap-on bomb guidance

AAZN

**Automatic electronic antenna coupler
High atomic number dosimetry
High cyclic rate weapons
Living Q fever vaccine
Multimode airborne intercept radar
Three hot cell fires**

AAZNZ

Lightweight gyro azimuth surveying instrument
Modular chemical agent detection system
Precise wide angle optics projection
Single phased array radar system

AAZNZ

Ultra high quality periscope imagery recorders

AAZR

High speed bulk storage device

AAZZN

Miniaturized acoustic lens imaging sonar

AAZZN

Vertical take-off escape system ejection applications

AAZZR

Adjustable superconducting point contact device

AAZZZ

Automated low cost production system
Dynamic in-house flight test program
Global spectral wave forecast model
HF digital data link tests
Lethal chemical agent materiel testing
Mobile tactical exercise control system
Second small size field test
Ultra high speed recording communications
Worldwide topographic system data bank

AAZZZZ

Automatic time-ordered air traffic control system
Clip-on small arms weapon fire simulator
Naval single sideband communication data systems
Valid small arms requirements data base

AA+AAN

High energy-density and high power-density batteries

AA+AAZ

Under-ice geophysical and oceanographic environmental complexes

AA+BZ

Adverse environmental and operational conditions

AA+N

Acousto-optical piezoelectric and galvanometer
Flame incendiary and smoke

AA+NZ

Physical biotic and culture factors
Volatile semi-volatile and decomposition products

AA+Z

Chemical physical and sensitivity
In-depth technical and cost
Scientific technical and management

AA+ZAZ

Shipboard underwater and field amphibious environments

AA+ZN

Beta gamma and neutron detection

AA+ZZ

Body-wing body-tail and body canards
Military educational and training problems
Quiet rotary-wings and STOL aircraft
Technological logistic and safety factors
Visual infrared and millimeter wavelengths

AA+ZZZ

Naval coastal and sea floor installations

ABAZ

Seeking new electronic components

ABZ

Compact operational configuration
Long complex structures
Modular local systems
Naval operational environment
Technical operational programs

ABZZ

Tactical new radio system

ANAAZ

Single magnetostriction free flooded ring

ANAN

Lower purity reactant gases

ANANN

Passive countermeasures electromagnetic sensors weapons

ANANZ

Portable Marcorps polyester-resin fiberglass system

ANAZ

Antifouling paints high flash
Internal cargo restraint system
Lightweight battalion mortar system
Low friction hydraulic fluid
Remote arm safe system
Warm fog dispersal techniques

ANAZN

High creep resistant metal composites

ANAAZ

Small ND yag electro-optically Q-switched laser

ANNN

Dynamic armor radar sensors

ANNZ

Airborne MTI radar techniques
Digital radar landmass simulation
Fine dendrite arm spacing
Mechanized infantry battalion force
Turbulent skin friction forces

ANNZZ

Unidirectional graphite graphite composite fibers

ANR

Night vision device
Thermal-electric cooling device

ANZAAZ

All-optical weapons load automatic positioning system

ANZAN

White phosphorus target marker warhead

ANZAZ

Rifles- foliage penetration radar-landing

ANZN

Digital troposcatter communications modems
High turndown ratio servovalve
Internal RFI power budgets
Shipboard laundry room fires

ANZNZ

Pure poison oak poison ivy

ANZZN

Underwater demolition team training stresses

ANZZZ

Nuclear weapons effects research test plan

AXAAZ

Digital or analog electrical signals

AXANZ

Gaseous or liquified carbon dioxide

AXZZ

Redundant or emergency operations

Remote or area alarm

Wet or dry suits

AZAAN

Long life miniature thermal batteries

AZAAZ

High speed morse telegraph terminal

High temperature stable organic materials

Man-made fire resistant cellulosic fibers

Winged missile structural captive loads

AZAAZZ

Free induction nuclear magnetic resonance flowmeter

High speed spiral bevel gear systems

AZAN

High altitude meteorological rockets

High temperature hydraulic fluids

High temperature O-ring seals

Long life self-lubricating bearings

Natural circulation naval boilers

Small engine internal aerodynamics

Wide angle optic head

AZANAZ

High power wideband UHF integrated circuit

AZANZ

High power S-band TWT tube
Integrated ground airborne avionics system
Wide band secure crypto equipment

AZANZZ

High efficiency linear SSB power amplifier
High performance electromechanical actuator control system

AZAR

Fluidic gun positioning device

AZAXZ

High temperature plastic or glass

AZAZAZ

Safe hospital electrical system technical requirements

AZAZN

Anti-submarine launched ballistic missile detection
High field cryogenically coated magnets

AZAZNZ

High strength high modulus carbon filament

AZAZZN

High temperature oxidation-resistant metal matrix composites

AZAZZZ

High power high energy laser devices
Low cost low weight cruise missile
Narrow band secure voice system equipment
Three camera wide angle TV system

AZA+AZ

Nuclear reaction cross-sections and nuclear radiation

AZA+YZ

High expansion foam and other agents

AZA+Z

Ionizing radiation injury-prevention and treatment

AZA+ZZ

Nonpathogen test agents- and support research

AZBZ

Amphibious warfare operational requirements
Semi-automatic flight operational center

AZNAAZ

Thin shell magnetostriiction free flooded ring

AZNAN

High power silicon controlled rectifiers

AZNAZ

High power silicon controlled rectifier

AZNAZZ

Phased array radar EM performance measurement

AZNN

High resolution ASW ABN
Hydraulic fluid contamination monitor
Multiple cutting subprojectile cartridges
Strategic structures vulnerability hardening

AZNNZ

High temperature vibration damping materials
Integrated body armor flotation project

AZNR

Inflatable air bladder device
Narrow band speech device

AZNZAZ

Five-year personnel armor system technical plan

AZNZZ

High strength beryllium oxide alloys
Long wave length grating monochromator
Rotary wing VTOL instrument training
Strategic attack fallout prediction system

AZNZZZ

Deep sea divers hose material requirements
Variable stability VTOL aircraft research program

AZRZ

Hydrazine-hydrazine nitrate blend fuel

AZZAAN

Low temperature irradiation sterilizer canned ham

AZZAN

Convective air masses non-volatile nuclei
Epoxy matrix filament reinforced composites

AZZANZ

High yield strength structural titanium alloys

AZZAZ

Circular air foil shaped grenade
Elastic pitch beam tail rotor
High aspect ratio planing surface
High flash point hydraulic oil
High pressure impact resistant materials
Human relations training pilot programs
Low energy loss drive vehicle
Nuclear cloud surveillance portable weather

AZZAZN

High energy product high temperature magnets

AZZAZZ

Close-support STOL aircraft floating platform analyses
Marine gas turbine hot section alloys

AZZNN

Augmented sea water corrosion inhibition

AZZNZ

Automated tissue cell culture control
Electron beam projection masking technique
High pressure mass spectroscopy studies
Internal combustion engine cooling systems
Semi-active laser paveway bombing system

AZZNZZ

Airborne dry material radar recording breadboard

AZZR

Digital message entry device
Random-access mass storage device

AZZZAZ

High strength weight filament reinforced plastics

AZZZN

High pressure air compressor lubricants
Variable area power turbine geometry

AZZZNZ

Regenerative air cycle ground cooling system

AZZZR

Digital input output display device

AZZZN

Automatic voice frequency circuit quality monitor

AZZZZ

Airborne weapon system data processing requirements
Automated jet engine fuel control test
High altitude research probe equipment project
High performance liquid propellant gun system
Low air pollution fire fighting simulator

A+AAAZ

Stable and mobile ocean-going semi-submersible platform

A+AAN

Cold and high terrestrial elevation

A+AANZ

Man-portable and mechanized flame weapons systems

A+AAR

Small and economical optical device

A+AAZ

AC and DC superconducting machines
Binary and biternary PCM-FM signals
Chemical and biological protective handwear
Infrared and ramon spectral data
Normal and military environmental conditions
Strategic and tactical nuclear forces
Topographic and military geographic support
Vertical and horizontal defensive construction

A+AAZZ

Airborne and shipboard acoustic survey techniques
Portable and fixed automatic alarm systems

A+ABZ

Fixed and adaptive real time

A+ANN

Arterial and venous blood oxygen

A+ANZ

Cold and high elevation regions
Lethal and incapacitating CB agents

A+AR

Sequential and simultaneous lobing

A+AZAZ

Mid and long range strategic forecasts

A+AZN

Commercial and military specification lubricants
Magnetic and electric field sensors
Single and multiple round shots

A+AZNZ

Structural and high temperature damping materials

A+AZZN

Western and eastern equine encephalitis vaccines

A+AZZZ

High and low cycle fatigue crack growth

A+BN

Occupational and operational hazards

A+BZ

Climatic and operational environments
Environmental and operational tests
National and local level
Qualitative and quantitative estimates

A+NAZ

Flame and smoke generating devices
Stable and creep resistant materials

A+NN

Flame and fragmentation weapons
Regulatory and stress physiology

A+NZ

Aerodynamic and vibration regimes
Carbon-ceramic and PTFE liners
Infra-red and radar imagery
Mechanical and corrosion testing
Restraint and survival systems
Thermal and humidity protection

A+NZN

Fresh and seawater fuel contamination

A+NZZ

Auroral and arctic propagation paths

A+XAAZ

Tumbling and or violent oscillatory motion

A+XBZ

Qualitative and or quantitative requirements

A+XZ

Technical and or performance

A+ZAZ

Manipulate and display coastal information
Static and wind tunnel tests

A+ZAZZ

Ballistic and crash resistant fuel systems

A+ZN

Airborne and submarine sonar
Electrostatic and laser gyros
Subluminous and degenerate stars

A+ZNN

Underwater and submarine periscope photography

A+ZNZ

Accelerated and field validation tests
Harmonic and wave distortion elimination
Thermal and air blast environments

A+ZNZ

Single and diversity CVA antenna systems

A+ZZN

Fresh and salt water ice

A+ZZZ

Biological and liquid metal attack
Controlled and reproducible materials properties
Fresh and sea water systems
Mechanical and data processing problems
Normal and emergency flight conditions
Shipboard and Navy school training
Technical and system control equipment
Thermal and flight load environments
Ultra-violet and visible wave lengths

A+ZZZZ

Aerodynamic and aircraft space penalties making

BAAN

New shipboard HF tuner

BAA

New intense celestial maser sources

BAAZ

Local decision-making social action
New chemical incapacitating agents
New flame incendiary agents
New mathematical statistical theory
New waterless hand cleaner

BAAZN

New rugged quick-drying cotton nylon

BAAZNZ

New double tunnel diode oscillator instrument

BAAZZ

New military geographic intelligence products
New shipboard arresting gear system

BAA+AZ

New bonded fire-retardant and ablative materials

BAN

New ballistic felts
New infrared sensors
New synthetic chemicals

BANN

New high permeability ferrite

BANZ

New flame weapons systems
New portable pier configurations
New wound ballistics model

BANZZ

New state-of-the-art survival radio set

BAR

Collision warning device
New signaling device

BAZ

Complex biological systems
Complex manual operation
Complex molecular systems
New animal tests
New biological assays
New ceramic materials
New clinical tests
New digital techniques
New hydraulic fluid
New manufacturing techniques
New organic materials
New protective coatings
New solid-state devices
Operational environmental conditions

BAZAAZ

New high performance recoverable aerial target

BAZANZ

New high strength beta titanium alloy

BAZAZ

New epoxy formula AC system

BAZN

New broad-frequency-range probe hydrophone

BAZNZ

New high strength aluminum alloy

BAZZ

New electronic rating structure
New high speed vehicles
New long range studies
New mental standards airman
New plastic spectacle frame

BAZZZ

New high-performance antenna system kit

BA+AAZ

New offensive and defensive chemical materiel

BA+AZ

New electrical and magnetic materials
New HF and VHF antenna

BA+AZZ

New atomic and molecular frequency sources
New transonic and supersonic flight vehicles

BA+ZZ

New domestic and foreign science

BBNZ

Complex new weapons system

BNAZ

New biisoquinoline chemiluminescent salts

BNN

New CB decontamination

BNNZ

New drifting ice floe

BNZ

Direct weapons effects
New aluminum alloy
New compiler systems
New disposal techniques
New ECM system
New ferrite material
New inflation systems
New weapons systems

BNZN

New petroleum base fluids

BNZZ

Direct oxidation fuel cells
New aluminum landing mats
New hands off technique

BNZZZ

New carbon fiber composite studies

BZ

Complex data
Complex structures
Direct current
Direct effect
Direct support
New aircraft
New cereal
New compounds
New data
New fibers
New information
New materials
New models
New problems
New program
New project
New studies
New techniques
New work
Operational data
Operational forces
Operational readiness
Operational safety
Operational tests
Quantitative information
Random plot
Real problems
Real time

BZAZ

Direct fire small arms
Real time auxiliary computer
Real time tactical systems

BZAZZ

New damage resistant machinery components
Real time naval control systems

BZAZZZ

New carrier high voltage power systems

BZN

New antiradiation chemicals
New engine oils
New glass reinforcement
New radio beacons
New vapor hazards

BZNZ

New metal carborance compounds

BZZ

Complex flow field
Direct computer access
Direct fire munitions
New bone pins
New control system
New fuel cell
New pan camera
New ship systems
New test tube
Operational life time
Random access memory
Real gas effects

BZZN

New battery case sealants

BZZNZ

New air surveillance radar system

BZZZ

Direct energy conversion techniques
New air defense gun
New carrier landing aid
Operational sea state clutter
Real time computer systems

BZZZZ

New air strike support system
New plasma arc flash system
New surface wave delay lines

BZZZZZ

New air defense computer simulation models

NAAAAAZ

Armor piercing follow-through pyrogenic flame system

NAAAZ

Titanium substituted barium-ferrite single crystal

NAABZZ

CIDS remote on-line real time mode

NAAN

Arthropod borne viral diseases
Medicine hazardous chemical disposal

NAAZ

Battalion lightweight mortar system
Fungus resistant solar heat
Pilots binocular visual system
Termite resistant electric cable

NANN

VLF floating wire antennas

NANNN

Fiberglas reinforced plywood tricon containers

NANZ

Avionics fault isolation system
Seawater hydraulic salvage tools

NANZZ

Oxidation resistant columbium alloy matrix

NAR

Eye protective device

NAZAZZ

Gats thin film Gunn

NAZN

Wire ringdown lines trunks

NAZZ

Eye safe laser transmitters
Hull propeller interaction studies
Sharp leading edge cylinder
UHF high power amplifiers

NAZZZ

Indium cold cathode field emitter
Man portable air defense system
Radar broad-band noise control techniques

NA+AZ

Radar reflecting and absorbing properties
Stress psychological and job environment factors

NA+Z

Hull lay-ups and materials

NA+ZN

Cargo restraint and aircraft tires

NA+ZZ

Prairie flat and dial pack

NNAAN

Tungsten wire reinforced Cb-Ti-Cr-Al composites

NNAN

Silicon carbide reinforced aluminum
Tungsten wire reinforced columbium

NNAZ

Rain erosion resistant coatings
Rain erosion resistant materials

NNNZ

Parachute vacuum drying system

NNZAZ

Gallium arsenide phosphide monolithic devices

NNZN

Helium speech processing electronics

NNZZZ

Concrete petroleum fuel storage tanks

NR

Droplet breakup
Flotation device
Muzzle device
Traction device

NZAANN

Graphite fiber reinforced pyrolytic graphite composites

NZAN

Beryllium filament reinforced titanium
Rubber water lubricated bearings

NZAZ

Aluminum alloy structural shapes
CW agent adsorption activity
Ordnance frequency agile radars
Weapons aiming visual display

NZAZZ

Grid wind tunnel computer technique
Lithium niobate single crystal ribbon

NZNAZ

Aluminum alloy titanium structural shapes

NZNN

Copper clad aluminum conductors

NZNZZ

CB cloud trajectory prediction method

NZZN

Cancer cell tissue culture

NZZZZ

ASW missile launching system components
Man machine systems personnel prediction
Radar broadband noise control techniques

NZZZZZ

SSN attack submarine fire control studies

ZAAAZ

Fiber reinforced plastic structural materials

ZAAAZZ

Wing mounted stereoscopic close circuit TV

ZAAN

Boiler auxiliary automatic startup
Fire resistant phenolic foams
Heat sterilized canned beef
Prototype digital planimetric compiler

ZAANZ

Instrumentation for- right vision tests
Pound controlled airdrop cargo system

ZAAR

Aircrew respiratory protective device

ZAAZ

Aircraft mechanical hydraulic equipment
Commanders passive right sight
Disseminating military geographic data
Modeling dynamic oceanographic conditions
Potential flame incendiary agents
Wing pylon mounted stores

ZAAZN

Field shelters- chemical agent detection

ZAAZNZ

Field use- chemical agent detection systems

ZAAZZ

Fiber reinforced plastic composite materials
Multishot portable flame weapon system
Potential lethal incapacitating riot control
Reliable ultra high frequency devices
Vapor deposited piezoelectric strain gauge

ZAAZZN

Shipyard automatic narrow gap butt welder

ZAAZZZ

Making valid large-scale accident effects predictions

ZAA+AZ

Disseminating bathymetric cartographic and navigational data

ZAA+ZZ

Field medical x-ray and recording system

ZANAAZ

Lipid extracted mycoplasma complement-fixing diagnostic antigen

ZANNZ

Antenna window rain erosion resistance

ZANRZ

Training night vision device operators

ZANZ

Army tactical weapons control
Influence intestinal iron absorption
Prototype centralized ATE system
Spin stabilized artillery shells

ZANZZ

Armys integrated battlefield control system
Noise cancelling microphone communication system
Prototype universal radar signal processor

ZAR

Navy technological projections

ZARZ

System technological projections strike

ZAZAAZ

Frequency modulated phase locked digital synthesizer

ZAZAZ

Army long range technological forecast
Impact high speed water-entry missiles
Transmission secondary electron thin films

ZAZN

Air regenerative cycle cooling
Dry polymeric amine CO
Potential chemical safety hazards
Speed heavy duty saws

ZAZNRZ

Prototype hydraulic pontoon causeway jacking system

ZAZNZ

Barrier coated bearing lubrication system
Reliable deep submergence hull material

ZAZR

Prototype wave-off decision device

ZAZZAZ

Vehicle hydraulic system maintenance diagnostic sets

ZAZZN

Carrier suppressed pulse duration modulation

ZAZZNZ

Diffusion bonded honeycomb core titanium panel

ZAZZN

Army Marine Corps ground combat armor

ZAZZZR

Prototype digital input output display device

ZAZZZZ

Army tactical satellite communications surface terminals
Potential tilt prop rotor aircraft configurations
Ship electrical power system compatibility studies

ZA+AZ

Aircraft avionic and electrical equipment
Aviation bio-medical and behavioral sciences
Electron scatter and dielectric properties
Light amphibian and amphibious vehicles

ZA+AZZ

Aircraft primary and automatic flight control
Field medical and dental treatment facilities

ZA+BZ

Document technical and operational requirements

ZA+N

Earth moving and excavation
Heat pipe and cooling

ZA+NZ

Aircraft static and lightning effects
Ships electronic and weapons systems

ZA+NZZ

Crystal puller and platinum resistance afterheater

ZA+YZ

Paint fabric and other surfaces

ZA+YZZ

STOL turnaround and other support operations

ZA+Z

Bridge wet and dry
Display drive and media
Shelter living and performance
Wind tunnel and range

ZA+ZN

Point positioning and land navigation

ZA+ZNZ

Gas chromatographic and ultraviolet detection techniques

ZA+ZZ

Pesticide dispersal and surveillance equipment
Processing geodetic and mapping data
Wind tunnel and flight test

ZA+ZZR

Fuel mixing and aircraft fuel dumping

ZA~ZZZ

Power drive and servo test facility
Wind tunnel and range test facilities

ZBAZZ

Test new interior coating materials

ZBAZZZ

Army direct aerial fire support system

ZBN

Aircraft operational fluids
Testing new insecticides

ZBZ

Army operational aircraft
Caliber direct fire
Navy operational systems
Simulate operational environments
Support new ship
Test new data

ZBZZ

Aid operational selection boards
Calculation complex rotor loads
Drawing operational sequence diagrams
Test new display devices

ZNAAZ

Air blast thermal underwater shock

ZNAN

Liquid helium nucleate boiling

ZNAZ

Air leakage sealing mechanisms
Black iron pipe shielding
Impact injury medical group
Training weapons firing ranges

ZNAZN

FM CW high resolution radar

ZNAZZ

Gas turbines piston engine starting

ZNBZZZ

Field artillery direct support weapon system

ZNNNN

Semitransparent gallium arsenide photocathodes substrate

ZNNZ

Ground MTI radar techniques
Shock vibration acceleration profiles

ZNNZZ

Prototype hydrazine monopropellant swimmer propulsion

ZNR

Prototype exoskeleton device

ZNZZZ

Aviation sleep work rest cycles
Sea ice dynamics field program

ZRZ

Electron device failures
Life saving gear
Training device requirement

ZZAANZ

Light weight doppler satellite-using navigation techniques

ZZAAZ

Cleaner burning liquefied natural gas

ZZAAZZ

Prototype computer assisted enlisted personnel distribution

ZZAN

Filling aircraft pressurized reservoirs
Pound class blunt weapons
State aircraft hydraulic fluids

ZZANZ

Base plant orthographic radar restitutor
Pound side shifting pallet transporter

ZZANZZ

Bomb rack stowed SAR drop raft

ZZAZAR

Command thrust prepackaged liquid hybrid engine

ZZAZN

Pollution abatement high energy chemistry

ZZAZZ

Aircraft engine trim test system
Ion chamber gamma rate meter
Prototype engine trim test system
Sea water hydraulic fluid ingibitors

ZZAZZZ

Air Force human resources laboratory support
Solid state electric logic distribution system

ZZA+AZ

Rotor blade leading and trailing edges

ZZA+Z

Alkyl ammonium phosphate and dibutyl

ZZA+ZZ

Ion mobility remote-Raman and laser systems

ZZBN

Ku band local oscillators

ZZBZ

Air Force operational environments
Field test new track

ZZBZZ

Field test new track PAD

ZZNAZN

Sea water contamination resistant gear oils

ZZNN

Wave wind stress climatologies

ZZNNZ

Weapon system survivability vulnerability studies

ZZNZ

Air defense IFF system
Area scanning LOPAIR alarm
Combat vehicle crew sizes
Envelope weight ejection seat
Land combat weapons systems
Nerve gas disposal ship
Solid earth geophysics phenomena
Thrust bearing machining failure
Wave resistance hull forms

ZZNZAZ

Envelope weight ejection seat structural model

ZZNZZ

Air launched ordnance support area
Aircraft weapon carriage launch prediction
Sea water lubrication bearing applications

ZZRZ

Army training device requirements

ZZZAZ

Air purifier system impermeable materials
Landing force assault amphibian vehicles
Solid state devices applied research

ZZZAZZ

Simulating gun barrel pressure-time loading conditions

ZZZNZ

Gas turbine ship seaway dynamics
Helicopter deliverable water purification units
Tropo link propagation modulation studies

ZZZNZZ

Light weight surface ASW weapon launcher

ZZZR

Vehicle energy conversion device

ZZZZBZ

Earth terminal earth terminal complex space

ZZZZN

Compliant surface fluid film bearings
Gas bearing spin motor gyroscope
Surface ship solid wastes incinerator

ZZZZNZ

Surface ship solid wastes incinerator compactor

ZZZZZZ

Air defense gun aircraft engagement model
Gun solid state scan converter tube
Plane wave spectrum surface integration technique